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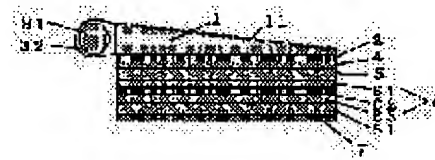
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(54) REFLECTION TYPE LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain a reflection type liquid crystal display device which has superior light effective utilization efficiency and is an easy-to-see display by obtaining a light guide plate suitable to a front light system.

SOLUTION: This liquid crystal display device is constituted by bringing a light guide plate 1 which emits side face incident light from the lower surface through prismatic unevenness formed on the top surface 11, in which the maximum intensity direction of the lower surface emitted light exists within 30° against the normal to the lower surface and the maximum intensity of the top-surface leak light within 30° is less than 1/5 of the maximum intensity of the lower surface and the lower surface incident light transmits from the top surface, into close-contact with a liquid crystal display element 6 equipped with a reflecting layer 7 through an adhesion layer 2 having 1.40 to 1.55 refractive index and $\geq 90\%$ all-light-beam transmissivity. Consequently, the lighting characteristics of a high light use rate that the lower-surface emitted light has superior perpendicularity and the top-surface leak light is hardly superimposed on a display image are obtained through the light guide plate, the device is excellent in contrast and a display image through the light guide plate is hardly disordered.



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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The side cross section of a reflected type liquid crystal display

[Drawing 2] The side cross section of other reflected type liquid crystal displays

[Drawing 3] Explanatory drawing of the display image by the example

[Drawing 4] Tropia explanatory drawing of a light guide plate

[Drawing 5] Side explanatory drawing of other light guide plates

[Drawing 6] Side explanatory drawing of prism-like irregularity

[Drawing 7] Explanatory drawing of the outgoing radiation property of the light guide plate by the example

[Drawing 8] The side cross section of surface light source equipment

[Drawing 9] Explanatory drawing of the outgoing radiation property by the conventional example

[Drawing 10] Explanatory drawing of the display image by the conventional example

[Description of Notations]

1: Light guide plate

11, 16, 17: Upper surface

2a: Heights 2b: Crevice

21 23: Shorter side side 22 24: Long side

12: Inferior surface of tongue

13: Incidence side

2: Glue line

3: Surface light source equipment

31: Light source

4: Diffusion layer

5 51: Polarizing plate

6: Liquid crystal display element

7 64: Reflecting layer

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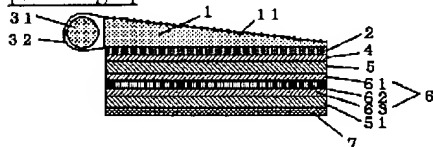
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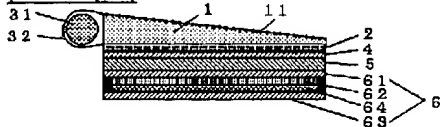
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DRAWINGS

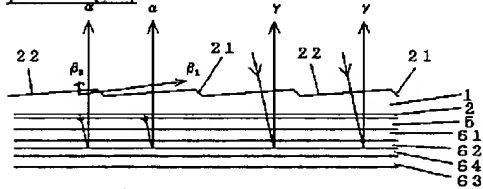
[Drawing 1]



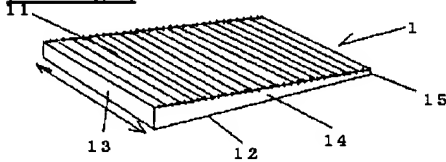
[Drawing 2]



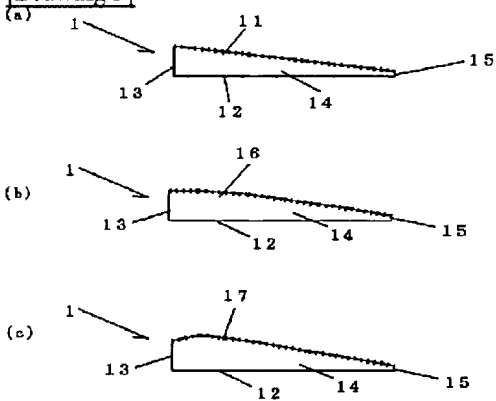
[Drawing 3]



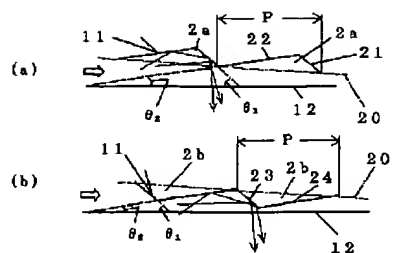
[Drawing 4]



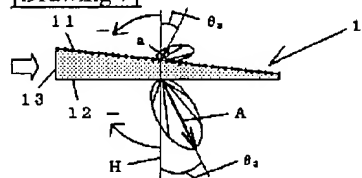
[Drawing 5]



[Drawing 6]



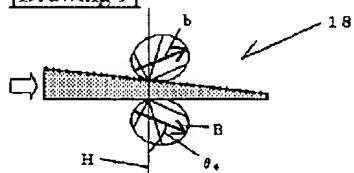
[Drawing 7]



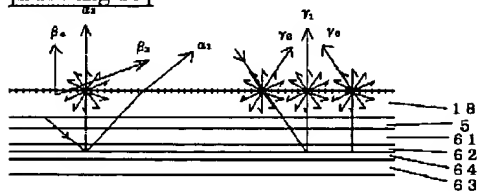
[Drawing 8]



[Drawing 9]



[Drawing 10]



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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] this invention is excellent in the deployment efficiency of light, and relates to the reflected type liquid crystal display of a bright and legible display.

[0002]

[Background of the Invention] In order to enable the check by looking in the dark space of a reflected type liquid crystal display etc., development of the front light system which arranges the light guide plate which carries out outgoing radiation of the incident light from the side from one side of a vertical side through an optical outgoing radiation means through an air space to the check-by-looking side of a liquid crystal display element is tried, and the suitable light guide plate for this front light system is examined variously.

[0003] However, the large reflection loss at the air space which intervenes between a light guide plate and a liquid crystal display element occurred, the fall of a luminosity, the check-by-looking prevention by the reflected light, etc. were caused, and there was a trouble that visibility fell greatly.

[0004]

[The technical technical problem of invention] this invention makes it a technical problem to obtain the suitable light guide plate for a front light system, to excel in the deployment efficiency of light and to obtain the reflected type liquid crystal display of a bright and legible display.

[0005]

[Means for Solving the Problem] this invention carries out outgoing radiation of the incident light from the incidence side from an inferior surface of tongue through the optical outgoing radiation means which consists of prism-like irregularity formed in the upper surface. While the maximum on-the-strength direction of the outgoing radiation light from an inferior surface of tongue is in less than 30 degrees to the normal over the base plane of the inferior surface of tongue and the maximum intensity of the leakage light from the upper surface in the direction of the less than 30 aforementioned degrees is 1/5 or less [of the aforementioned maximum intensity in an inferior surface of tongue] The reflected type liquid crystal display characterized by carrying out adhesion arrangement of the liquid crystal display element to which the incident light from an inferior surface of tongue possesses a reflecting layer through the glue line of refractive indexes 1.40-1.55 and 90% or more of all light transmissions in the inferior-surface-of-tongue side of the light guide plate penetrated from the upper surface is offered.

[0006]

[Effect of the Invention] While inferior-surface-of-tongue outgoing-radiation light is excellent in the directivity to a perpendicular direction, and leakage light from the upper surface cannot overlap a display image easily, can acquire the lighting property of excelling in the deployment efficiency of light, is excellent in the contrast in the check by looking at the time of an astigmatism LGT and lighting and excellent also in the luminosity of a display through the light guide plate according to this invention, the reflected type liquid crystal display which the display image through the light guide plate cannot be easily confused, and is excellent in legibility can obtain.

[0007]

[The operation gestalt of invention] The reflected type liquid crystal display by this invention minds [inferior-surface-of-tongue / of the light guide plate which the incident light from an inferior surface of tongue penetrates from the upper surface] the glue line of refractive indexes 1.40-1.55 and 90% or more of all light transmissions. Adhesion arrangement of the liquid crystal display element possessing a reflecting layer is carried out. as the light guide plate Outgoing radiation of the incident light from the incidence side is carried out from an inferior surface of tongue through the optical outgoing radiation means which consists of prism-like irregularity formed in the upper surface. The maximum on-the-strength direction of the outgoing radiation light from an inferior surface of tongue is in less than 30 degrees to the normal over the base plane of the inferior surface of tongue, and that whose maximum intensity of the leakage light from the upper surface in the direction of the less than 30 aforementioned degrees is 1/5 or less [of the aforementioned maximum intensity in an inferior surface of tongue] is used.

[0008] The example of the reflected type liquid crystal display by this invention was shown in drawing 1 and drawing 2 . For 1, a light guide plate and 2 are [a glue line and 6] liquid crystal display elements. Moreover, the example of said light guide plate was shown in drawing 4 and drawing 5 (a) - (c). It is an opposite edge [as opposed to / the upper surface in which an optical outgoing radiation means by which 11, 16, and 17 consisted of prism-like irregularity was formed, the inferior surface of tongue where 12 becomes an optical outgoing radiation side, and 13 are the incidence sides, and / as opposed to / the horizontal side / in 14] the

incidence side in 15 /.

[0009] A light guide plate carries out outgoing radiation of the incident light from the incidence side from an inferior surface of tongue through the optical outgoing radiation means which consists of prism-like irregularity formed in the upper surface, and consists of a tabular object which generally has the upper surface, the inferior surface of tongue which counters it, and the incidence side which consists of the side between vertical sides. what has the thickness of the opposite edge 15 which counters the incidence side 13 like the example of drawing preferably thinner than that of the incidence side although this thick plate etc. is sufficient as a tabular object -- it considers as 50% or less of thickness above all

[0010] There is an advantage which can carry out incidence to the optical outgoing radiation means formed in the upper surface by the time the light which carried out incidence from the incidence side like ***** shown in drawing 6 and drawing 7 reached the opposite edge efficiently, can carry out outgoing radiation from the undersurface through reflection etc., and can supply an incident light to the purpose side efficiently, and can lightweight-ize a light guide plate by ****-ization of the aforementioned opposite edge. Incidentally, when the upper surface is a straight-line side like drawing 5 a, it can consider as about 75% of weight of the light guide plate of uniform **.

[0011] Although the prism-like unevenness which forms an optical outgoing radiation means can be formed also in the heights or the crevice which consists of an equilateral side, it is more desirable than points, such as use efficiency of light, to form in the heights or the crevice which consists of a shorter side side and a long side. The example of the prism-like unevenness was shown in drawing 6 (a) and (b). 2a is heights, 2b is a crevice, and a shorter side side, and 22 and 24 are [21 and 23] long sides. In addition, based on the straight line which connects the intersection of a shorter side side a long side, etc. and its forming face, heights or the crevice has become depressed, or (concave) depends (convex).

[0012] That is, when based on the thing of the instantiation to drawing 6, based on the straight line 20 shown by the imaginary line which connects the intersection of the shorter side side which forms heights 2a or crevice 2b, and the forming face of a long side (21, 22, or 23 and 24), it has become depressed or (concave) depends (convex).

[0013] The light guide plate by this invention has the direction theta 3 of the maximum intensity A in the outgoing radiation light from the undersurface 12 of the incident light (*****) from the incidence side 13 in less than 30 degrees to the normal H over a base plane at the bottom (the direction of a transverse plane), as illustrated to drawing 7, and the maximum intensity of the leakage light from the upper surface in the direction of the less than 30 aforementioned degrees is 1/5 or less [of the aforementioned maximum intensity A in the undersurface].

[0014] The leakage light from said upper surface tends to overlap the reflected light of the light which shows the maximum intensity A through the reflecting layer, if the maximum intensity ratio of the aforementioned upper surface leakage light / undersurface outgoing radiation light is large, will tend to reduce the strength of a display image relatively, and will be easy to reduce contrast.

[0015] namely, as shown in drawing 9 and drawing 10, with the light guide plate made into an optical outgoing radiation means, a conventional diffusion dot and conventional detailed irregularity The transmission light which carried out incidence from the side by dispersion by the optical outgoing radiation means of a light guide plate 18 is mostly emitted to an omnidirection. The outgoing radiation light alpha 1 from the undersurface and the leakage light beta 3 from the upper surface show the maximum intensity B and b in the direction theta 4 of about 60 degrees to the normal H over the undersurface with the dispersion property. Since the same is almost said of the intensity, The quantity of light in about 15 lengthwise upper parts - about 30 lower parts, and the viewing-angle range of about 30 lateral right and left becomes it is few and deficient in the luminosity of a display on the basis of a direction effective in a check by looking, especially the aforementioned normal. Moreover, while the outgoing radiation light alpha 2 from the undersurface which forms a display image overlaps the leakage light beta 4 from the upper surface and becomes scarce at contrast In the time of an astigmatism LGT, it becomes deficient in contrast by white dotage of the display image by the aforementioned scattered light gamma 2, the display light gammal and gamma3 is mixed up by dispersion by the light guide plate, and a display image is disturbed remarkably.

[0016] Also with moreover, the light guide plate which has the prism type light outgoing radiation means which consists of the 45-degree slant face and the level surface by JP,62-73206,A The outgoing radiation light from the undersurface in which has much leakage light from the upper surface like the above, and it forms a display image is overlapped, contrast is reduced, and there is little quantity of light of a direction there is much outgoing radiation light with a large outgoing radiation angle, and effective in a check by looking, the luminosity of a display is reduced, and the fall problem of display grace is generated.

[0017] Therefore, the directivity of the incident light from the side is better for formation of a bright and clear display image than the undersurface so that according to the above-mentioned this invention, and drawing 7 is asked for outgoing-radiation A It being the near angle theta 3 as much as possible, and being the light guide plate to carry out with sufficient condensing nature in the especially aforementioned viewing-angle range in the direction of the normal H over the undersurface like instantiation above all at it.

[0018] Moreover, in the reflected type liquid crystal display, equalization and clarification of a display are usually attained through the split-face system reflecting layer whose degree of average diffusion angle is about 5 - 15 degrees. Therefore, if a reflecting layer has much light which carries out incidence at a large angle like the aforementioned conventional light guide plate drawing 9 : B, drawing 10 : alpha 1), the quantity of light of a direction effective in a check by looking will decrease, and a bright display will be difficult, and it will be easy to produce reversal of a display in a check by looking of a large angle, and will become easy to generate problems, like color change becomes large in an electric-field birefringence type display.

[0019] It is called for not overlapping still as as much as possible as the outgoing radiation light A from the undersurface in which the leakage light a from the upper surface forms a display image like instantiation in drawing 7 which the influence which

duplication of leakage light and a display image has on a contrast ratio since it is the contrast ratio of 1:5-1:20 usually in a reflected type liquid crystal display was large, and was described above for improvement in contrast, especially that there is little duplication in the aforementioned viewing-angle range as much as possible.

[0020] A light guide plate more desirable than points, such as improvement in display grace, such as a luminosity at the time of considering as the above-mentioned reflected type liquid crystal display and contrast, has the less than 25 directions theta 3 of the above-mentioned maximum intensity A in drawing 7 within especially 20 degrees above all less than 28 degrees in the vertical plane (cross section on drawing) to both the base planes of the incidence side 13 and the undersurface 12 like instantiation.

[0021] In addition, when the incidence side 13 side is made into the negative direction on the basis of the aforementioned normal H, the intensity of the leakage light a from the upper surface 11 of the same angle theta 3 as the direction of the maximum intensity A \angle is that $1/10$ or less it is [of the maximum intensity A concerned] a small value as much as possible, and the thing which is $1/20$ or less especially $1/15$ or less above all. Since the leakage light a concerned overlaps the mirror reflection direction of the light which shows the maximum intensity A, when the value of the aforementioned a/A was large, as it described above, it reduces the strength of a display image relatively, and reduces contrast.

[0022] An optical outgoing radiation means more desirable than the point of attaining properties, such as the aforementioned maximum on-the-strength direction, and the maximum intensity / leakage light intensity ratio, etc. consists of a repetitive construct of the prism-like unevenness (2a or 2b) which the tilt angle to the base plane of the undersurface 12 becomes from the shorter side side (theta 1) and the $0^\circ - 10^\circ$ long side (theta 2) which are $30^\circ - 45^\circ$ degrees, as illustrated to drawing 6.

[0023] In the above, the shorter side sides 21 and 23 formed as a slant face which carries out a declivity to an opposite edge (15) side from an incidence side (13) side carry out the role which reflects in the field the light which carries out incidence among the incident lights from the side, and is supplied to the undersurface (optical outgoing radiation side). In this case, by making the tilt angle theta 1 of a shorter side side into $30^\circ - 45^\circ$ degrees, as illustrated by the broken line arrow to drawing 6, the undersurface outgoing radiation light which reflects transmission light with sufficient perpendicularity to the undersurface, and shows the direction theta 3 of the maximum intensity A to less than 30° degrees to the normal H at the bottom like drawing 7 is obtained efficiently.

[0024] The tilt angle theta 1 with a shorter side side more desirable than points, such as the aforementioned performances, such as suppression of leakage light and suppression of the check-by-looking disturbance by it, is $35^\circ - 42^\circ$ degrees above all 32° to 43° degrees. In addition, the quantity of light which the tilt angle theta 1 of a shorter side side can use effectively for a check by looking by the maximum on-the-strength direction of undersurface outgoing radiation light serving as a large angle to a normal at less than 30° degrees decreases, a luminosity tends to fall, and if it exceeds 45° degrees, the leakage light from the upper surface will become easy to increase.

[0025] On the other hand, while the long side reflected the transmission light which carries out incidence to it and supplied it to the shorter side side, when it is made into a reflected type liquid crystal display, it aims at making the display image from a liquid crystal display element penetrate. As for the tilt angle theta 2 of the long side to a base plane (12) at the bottom, it is more desirable than this point that it is $0^\circ - 10^\circ$ degree.

[0026] As illustrated by the broken line arrow to drawing 6 with the above, the transmission light of a larger angle than the tilt angle theta 2 concerned carries out incidence to long sides 22 and 24, and it is reflected, and based on the tilt angle of the long side concerned, it is reflected by the undersurface 12 at an parallel angle in that case, incidence is carried out to the shorter side sides 21 and 23, and it is reflected, converges good by the aforementioned parallel-ization from the undersurface 12, and outgoing radiation is carried out.

[0027] While the transmission light which carries out incidence to a long side the aforementioned result in addition to the transmission light which carries out direct incidence to a shorter side side and which carries out incidence to a shorter side side through the reflection can also be supplied to an inferior surface of tongue by reflection through the shorter side side and can aim at improvement in the efficiency for light utilization of the part -izing of the incident angle of the light which it is reflected by the long side and carries out incidence to a shorter side side can be carried out [fixed], the variation in angle of reflection can be suppressed, and parallel condensing-ization of outgoing radiation light can be achieved.

[0028] Therefore, by adjusting the tilt angle concerned of a shorter side side and a long side, directivity can be given to outgoing radiation light and it becomes possible to carry out outgoing radiation of the light at a perpendicular direction or the angle near it to the undersurface by that cause.

[0029] If it becomes deficient in the effect that the tilt angle theta 2 concerned of a long side parallel-izes transmission light at 0 times and exceeds 10° degrees, the rate of incidence to a long side will fall, the optical supply to opposite one end will run short, and it will ununiformity-become easy toize luminescence. Moreover, also in the cross-section configuration of a light guide plate, thin shape-ization of opposite one end becomes difficult, the amount of incident lights to prism-like irregularity also decreases, and it becomes easy for luminous efficiency to fall. The tilt angle theta 2 with a long side more desirable than points by the formation of parallel light of transmission light, such as the aforementioned performances, such as condensing-izing of outgoing radiation light and suppression of leakage light, is 5 or less times above all 8 or less times.

[0030] Especially a long side more desirable than points, such as the visibility of the display image through the long side of the above-mentioned light guide plate, makes the angle difference of the tilt angle theta 2 less than 3 times less than 4 times above all less than 5 times with the whole light guide plate, and makes the difference of the tilt angle theta 2 between nearby long sides above all especially less than 0.1° degrees less than 0.3° degrees less than 1 time.

[0031] With the above, the influence a display image is influenced by difference of the tilt angle theta 2 of the long side to penetrate etc. can be suppressed. If the deviation of the transparency angle by the long side is greatly different with a place, it will

become an unnatural display image, especially if the deviation difference of a transmission image [near the proximity pixel] is large, it will be easy to become a remarkable unnatural display image.

[0032] The angle difference of said tilt angle θ_2 is premised on being in the range which is the 0° - 10° degree which the tilt angle θ_2 of a long side described above. Namely, this aims at not changing the optimal check-by-looking direction of the liquid crystal display which set up and optimized the viewpoint near the perpendicular direction on the assumption that the deviation of the display image by the refraction at the time of long side transparency is suppressed as an applied small tilt angle θ_2 and it considers as the inside of an allowed value.

[0033] If the deviation of a display image is large while the optimal check-by-looking direction will shift near the perpendicular direction, if a display image is deflected, it will approach in the direction of outgoing radiation of the leakage light from the light guide plate upper surface, and will become [the] easy to be influenced, such as a fall of contrast. In addition, considering as the thing of a grade which can also disregard the influence of distribution of the transmitted light etc. is included in the conditions which make the tilt angle θ_2 of a long side 0° - 10° degree.

[0034] Prevention of disturbing a display image is asked for the light penetrated on the upper surface not being scattered about as much as possible from the undersurface and the undersurface from the upper surface like the above. The front light prepared in a reflected type liquid crystal display Since it is the source of a fill-in flash which enables a check by looking in a dark place and is originally the check by looking by use of outdoor daylight, such as an indoor light aiming at reduction of power consumption, and the natural light If the incidence of outdoor daylight is checked with a light guide plate in the state of the original astigmatism LGT, a display will become dark, and when dispersion is produced with a light guide plate, disorder by the fall of the contrast by the surface white blush mark, jumble of a display image, etc. will arise.

[0035] The light guide plate which is excellent in the incidence efficiency of outdoor daylight, and is excellent in the rate of the transmitted light or outgoing radiation efficiency of a display image by the liquid crystal display element is more desirable than the point of obtaining a bright display image. It is more desirable than this point that the projected area of the long side to a base plane at the bottom considers as the optical outgoing radiation means of that of a shorter side side which consists of prism-like irregularity of 15 times or more especially 10 or more times above all 5 or more times. Thereby, most display images by the liquid crystal display element can be made to penetrate through a long side.

[0036] In addition, on the occasion of transparency of the display image by the liquid crystal display element, it is reflected in an incidence side side and outgoing radiation of the display image which carried out incidence to the shorter side side is not carried out from the upper surface, or it is deflected in the greatly different direction of anti-one end, carries out outgoing radiation to the display image of the long side transparency on the basis of the normal over the undersurface, and hardly affects the display image through the long side. Therefore, as for a shorter side side, it is more desirable than this point not to **** to the pixel of a liquid crystal display element. When a shorter side side's overlapping to the whole surface of a pixel, speaking in extreme argument incidentally, a check by looking of the display image near the perpendicular direction through the long side almost becomes impossible.

[0037] Therefore, it is more desirable than the point of preventing a display and a bird clapper insufficient [transparency of display light], and unnatural etc. to secure sufficient light transmittance which made small area to which a shorter side side overlaps a pixel, and minded the long side. When the pixel pitch of a liquid crystal display element is temporarily set to 100-300 micrometers, as for a shorter side side, it is more desirable than the aforementioned point to be formed based on the projection width of face to a base plane at the bottom, so that 1-20-micrometer 40 micrometers or less may turn into 5-15 micrometers especially above all.

[0038] Moreover, since it is the substantial outgoing radiation functional division of a side incident light as the shorter side side was described above by one side although the interval of a shorter side side has a large thing more desirable than the aforementioned point When the interval was too large, and the lighting at the time of lighting becomes a non-dense, and may serve as a too unnatural display and an example is taken in them, as illustrated to drawing 6, as for the recurrence pitch P of the prism-like unevenness 2a and 2b, it is desirable to be referred to as 50 micrometers - 1.5mm. In addition, a pitch may be fixed and may be irregular like what combined the pitch unit of a random pitch or a predetermined number at random or regularly, for example.

[0039] In the case of the optical outgoing radiation means which consists of prism-like irregularity, it may interfere with the pixel of a liquid crystal cell, and moire may be produced. Since the pixel pitch of a liquid crystal display is about 50-500 micrometers usually, the influence to the transmitted light of a light guide plate is suppressed as much as possible, to be able to check by looking clearly the information whose pitch is about 50 micrometers is desired, and good display grace which also suppressed the moire by interference with a pixel in that case is also desired.

[0040] Although prevention of said moire can be performed by adjusting the pitch of the prism-like irregularity which forms an optical outgoing radiation means, as described above, there is a desirable range in the pitch of prism-like irregularity. Therefore, a solution in case moire arises in the desirable pitch range poses a problem.

[0041] In this invention, the method which forms prism-like irregularity in an inclination state to the base plane of the incidence side, and prevents moire is desirable so that prism-like irregularity can be arranged in the state of intersection to a pixel. In this case, if a tilt angle is too large, a deviation is produced in reflection through the shorter side side, a big bias occurs in the direction of outgoing radiation light, the anisotropy of the luminescence intensity in the direction of an optical transmission of a light guide plate will become large, and efficiency for light utilization will also fall and it will tend to cause [of display grace] a fall.

[0042] As for especially the tilt angle of the array direction of a ridgeline of the prism-like unevenness to the base plane of the incidence side, i.e., the direction of prism-like irregularity, it is more desirable than the aforementioned point that it takes less than

**25 degrees for less than **20 degrees above all less than **30 degrees. In addition, the sign of ** means the direction of the inclination on the basis of the incidence side. When moire can be disregarded, the array direction of prism-like unevenness is so desirable that it is parallel to the incidence side.

[0043] A light guide plate can be made into a proper gestalt as described above. When considering as a wedge etc., the configuration can be determined suitably and can be made into a proper field configuration like the curved surfaces 16 and 17 like instantiation at the straight-line side 11 like instantiation, and drawing 5 (b) and (c) at drawing 5 (a).

[0044] Moreover, the prism-like irregularity which forms an optical outgoing radiation means does not need to be formed in drawing 6 in respect of [21, 22, 23, and 24] the straight line of instantiation, either, and may be formed in the proper field gestalt including a refracting interface, a curve side, etc. Moreover, prism-like irregularity may consist of combination of the irregularity from which a configuration etc. differs in addition to a pitch. Furthermore, prism-like irregularity may be formed as a series of heights or crevices where the ridgeline continued, and may be formed in the direction of a ridgeline which has a predetermined interval and was arranged discontinuously as intermittent heights or a crevice.

[0045] About the configuration of the inferior surface of tongue in a light guide plate, or the incidence side, there is especially no limitation and it may be determined suitably. Although it generally considers as the perpendicular incidence side from a flat side to the inferior surface of tongue to cut and an inferior surface of tongue, about the incidence side, improvement in the rate of an incident light can also be stretched, for example as a configuration according to the periphery of the light sources, such as a curve concave, etc. It can also consider as the incidence side structure of having the induction which furthermore intervenes between the light sources etc. The induction can be made into a proper configuration according to the light source etc.

[0046] In addition, a hard-coat layer can also be prepared in the front face on the upper surface of a light guide plate if needed for the purpose of making the optical outgoing radiation property which prevented and described above wear by the blemish, eradication of an optical outgoing radiation means, etc. maintain at a long period of time etc. A hard-coat layer can be formed as a proper transparent hard film by the proper formation method according to the former like the coating film of hard polymer, such as glass material, such as a silicon dioxide and a zirconia, a vacuum evaporation film which consists of hard-glass material above all, a silicone system, and a fluorine system, etc.

[0047] moreover, when it checks by looking from the upper surface in the inferior surface of tongue of a light guide plate, an optical outgoing radiation means and it are ***** by the check-by-looking direction on the inferior surface of tongue -- detailed irregularity structure can also be given if needed for the purpose of prevention of deterioration of the display grace by the moire phenomenon which patterns interfere and forms an interference fringe etc. The detailed irregularity can be formed by the proper method according to the conventional diffusion layers, such as a split-face-ized method for example, under a light guide plate, and a method which attaches the resin layer and diffusion sheet of transparent particle content to a light guide plate inferior surface of tongue.

[0048] Furthermore, reflection by the inferior surface of tongue can be suppressed in the inferior surface of tongue of a light guide plate, and an acid-resisting layer can also be prepared in it if needed for the purpose of the cause of a fall of the contrast of a display image, and prevention of a bird clapper etc. as a leakage light to the upper surface. An acid-resisting layer can be formed by the proper method according to the former like the sheet which attached the optical multilayer and low refractive-index layer which consist of a transparent dielectric, fluorine content polymer, low density material, etc., for example, and it.

[0049] In the above, all the light transmissions of the incident light of the direction of a vertical side, especially the vertical-incidence light from an inferior surface of tongue to the upper surface are 95% or more 92% or more above all 90% or more, and Hayes of especially a light guide plate more desirable than the point of preventing a check-by-looking property falling by disorder of the display image by dispersion, and attaining a clear display image etc. is 20% or less of especially thing 30% above all 45% or less.

[0050] A light guide plate can be formed with a proper material which shows it transparency according to the wavelength region of the light source. Incidentally a transparent resin, glass, etc. which are represented with an acrylic resin, a polycarbonate system resin, an epoxy system resin, etc., for example are raised in a light region. The light guide plate which did not show a birefringence or was formed with a small material of a birefringence is used preferably.

[0051] A light guide plate can be formed also by the cutting method, and can be formed by the proper method. As the manufacture method more desirable than points, such as mass-production nature How to imprint a ***** configuration under heating to the metal mold which can form a predetermined configuration for thermoplastics, The method of filling up or casting and carrying out polymerization of the liquefied resin which can carry out polymerization to the mold which can form a predetermined configuration with the method and heat with which the metal mold which can fabricate the resin made to fluidize through the thermoplastics or the heat which carried out heating melting, or a solvent in a predetermined configuration is filled up, ultraviolet rays or radiation, etc., etc. is raised.

[0052] In addition, although the light guide plate pasted up the sheet in which optical outgoing radiation meanses, such as prism-like irregularity, were formed, in this invention on the light guide section which bears transmission of light, it does not need to be formed as a like and may be formed as layered product of parts which consist of homotypic or material of a different kind etc., and according to one sort of material one-monolayer object. The size of the liquid crystal display element for application, the size of the light source, etc. can determine the thickness of a light guide plate suitably. Especially general thickness is 0.5-8mm 0.1-10mm above all 20mm or less based on the incidence side.

[0053] The reflected type liquid crystal display by this invention carries out adhesion arrangement of the liquid crystal display element which possesses a reflecting layer in the inferior-surface-of-tongue side of a light guide plate through the glue line of refractive indexes 1.40-1.55 and 90% or more of all light transmissions. By using the above-mentioned light guide plate, the

reflected type liquid crystal display which is excellent in low-power nature it is bright and legible can be formed. In this case, as illustrated to drawing 8, a light guide plate can also be used for the incidence side 13 as side light type surface light source equipment 3 which arranges the light source 31 and becomes.

[0054] According to the light guide plate by this invention, it penetrates from an inferior surface of tongue or the upper surface to fitness, and the incident light from the upper surface and an inferior surface of tongue can carry out outgoing radiation of the light which turned in parallel with high precision in the direction which is excellent in perpendicularity advantageous to a check by looking, can form the surface light source equipment which is excellent in a luminosity, using the light from the light source efficiently, and can obtain the reflected type liquid crystal display of said outstanding performance.

[0055] A proper thing can be used as the light source arranged on the incidence side of the light guide plate in surface light source equipment. general -- for example, (cold, heat), lines, such as a cathode-ray tube, -- the array object which arranged the point light sources, such as the light source and light emitting diode, and it a line, in the shape of a field, etc., or the point light source -- the line of regularity or an unfixed interval -- the light source using the equipment changed into a luminescence state etc. can use preferably A cold cathode tube is more desirable than especially points, such as low-power nature and endurance.

[0056] On the occasion of formation of surface light source equipment, it can also consider as the combination object which has arranged proper auxiliary means, such as the light source electrode holder 32 which surrounds the light source in order to lead the emission light from the light source 31 to the incidence side of a light guide plate 1 like drawing 8 if needed, and the diffusion layer 4 arranged on the inferior surface of tongue of a light guide plate in order to obtain equal field luminescence.

[0057] Generally as a light source electrode holder, a resin sheet, a metallic foil, etc. which attached the high reflection factor metal thin film are used. When pasting up a light source electrode holder on the edge of a light guide plate through adhesives etc., formation of an optical outgoing radiation means can also be omitted about a part for the jointing.

[0058] A diffusion layer is beforehand arranged if needed on the optical outgoing radiation side of surface light source equipment, therefore the inferior surface of tongue 12 of a light guide plate 1 for the purpose of the equation of the luminosity by prevention of light-and-darkness nonuniformity, reduction of the moire by jumble of a contiguity beam of light, etc. In this invention, a diffusion layer with the diffusion range narrower than points, such as directive maintenance of light guide plate outgoing radiation light and deployment efficiency of light, can use preferably.

[0059] The method which carries out application hardening of the transparent resin which distributed the method which makes it distribute and carries out application hardening of the transparent particle of a high refractive index into the transparent resin of a low refractive index according to the detailed irregularity of the undersurface which described the diffusion layer above, and air bubbles, It can form by the method with proper method which forms the transparent resin layer which has the method which makes a base-material front face swell through a solvent, and generates KUREIZU, and an irregular concavo-convex field or method using the diffusion sheet formed according to the above etc., and there is especially no limitation about the formation method. You may form the aforementioned irregular concavo-convex field in the front face of the application layer of a transparent resin prepared a base material and on it by the method with proper mechanical method which imprints split-face configurations, such as a split-face--ization-processed roll metallurgy type, or/, chemical preparation method, etc.

[0060] The reflected type liquid crystal display illustrated to above-mentioned drawing 1 and drawing 2 shows what used the light guide plate 1 as surface light source equipment 3, and used it for the front light system. For 5 and 51, as for a cell substrate and 62, a liquid crystal layer, and 7 and 64 are [a polarizing plate, and 61 and 63] reflecting layers. A reflected type liquid crystal display can form the liquid crystal display element 6 possessing reflecting layers 7 and 64 in the undersurface side of the light guide plate 1 in the optical outgoing radiation side of surface light source equipment, i.e., surface light source equipment, by carrying out adhesion arrangement through a glue line 2 like the example of drawing.

[0061] A reflected type liquid crystal display is formed by assembling suitably component parts, such as a phase contrast board for compensation the liquid crystal display element which generally consists of a liquid crystal cell of the transparent-electrode possession which functions as a liquid crystal shutter, a driving gear of accompanying in it, etc., a polarizing plate, a front light, a reflecting layer, and as occasion demands, etc.

[0062] Using the above-mentioned light guide plate or above-mentioned surface light source equipment, except for the point which carries out adhesion arrangement of the liquid crystal display element which possesses a reflecting layer in the light guide plate inferior-surface-of-tongue side through the glue line of refractive indexes 1.40-1.55 and 90% or more of all light transmissions, there is especially no limitation and it can be formed in this invention according to the former like the example of drawing. In addition, entry of a transparent electrode is omitted in the example of drawing 1.

[0063] Therefore, when there is especially no limitation about the liquid crystal display element to be used, for example, it is based on the orientation gestalt of liquid crystal, what has the proper liquid crystal display element of the twist system like TN type, a STN type, a perpendicular orientation cell type and a HAN cell type, and an OCB cell type, a non-twisting system, a guest host system, or a ferroelectric liquid crystal system etc. can be used. Moreover, there may not be especially limitation about the drive method of liquid crystal, either, for example, you may be proper drive methods, such as an active matrix and a passive matrix method.

[0064] In a reflected type liquid crystal display, although arrangement of reflecting layers 7 and 64 is indispensable, about the arrangement position, it can also prepare in the outside of the liquid crystal display element 6 like instantiation at drawing 1, and can also prepare in drawing 2 inside the liquid crystal display element 6 like instantiation. It can form as a proper reflecting layer according to the former which supported an attachment layer, and its coating layer and attachment layer of the metal thin film by a coating layer, a vacuum evaporation method, etc. which contain the powder of high reflection factor metals, such as **, for example, aluminum, silver and gold, copper, and chromium, in a binder resin just in the reflecting layer by the base material, such

as a reflective sheet and a metallic foil.

[0065] In addition, when forming a reflecting layer 64 in the interior of the liquid crystal display element 6 like drawing 2, the reflecting layer by the method which forms an electrode pattern with high conductivity material, such as the aforementioned high reflection factor metal, as the reflecting layer, the method which forms the transparent electric conduction film by the transparent-electrode formation material on a transparent-electrode pattern, for example is desirable.

[0066] Moreover, although a proper thing can be used as a polarizing plate, the high thing of degree of polarization can use preferably like the absorbed type linearly polarized light child of for example, an iodine system or a color system etc. from the point of obtaining the display of the good contrast ratio by the incidence of the advanced linearly polarized light etc.

[0067] In addition, on the occasion of formation of a reflected type liquid crystal display, the diffusion board formed, for example on the polarizing plate by the side of a check by looking, an anti glare layer, an antireflection film and a protective layer or a liquid crystal display element, and proper optical elements, such as a phase contrast board for compensation formed between polarizing plates, can be arranged suitably.

[0068] The aforementioned phase contrast board for compensation aims at compensating the wavelength dependency of a birefringence etc. and aiming at improvement in visibility etc. In this invention, it is arranged if needed between the polarizing plate by the side of a check by looking or/and a tooth back, and a liquid crystal display element etc. As a phase contrast board for compensation, a proper thing can be used according to a wavelength region etc., and it may be formed as a superposition layer of the phase contrast layer more than one layer or two-layer.

[0069] For the purpose of adhesion arrangement of the liquid crystal display element through the glue line by the side of the inferior surface of tongue of a light guide plate suppressing the reflection loss in those interfaces, as the glue line, refractive indexes are 1.40-1.55 and 90% or more of thing is used for all light transmissions from this point. The glue line which is excellent in all light transmissions above all is desirable, and especially all the light transmissions of 95% or more of thing are desirable.

[0070] Although the thickness of a glue line can be determined suitably, especially generally it is set to 15-500 micrometers 10-600 micrometers above all 5-800 micrometers from points, such as all the aforementioned light transmissions and adhesive strength. In addition, a refractive index can be suitably determined in [aforementioned] 1.40-1.55 according to the refractive index of an adhesion object etc. It is more desirable than the point of suppression of reflection loss etc. to consider as the glue line of a middle refractive index to the refractive index of the layer which adjoins the both sides of a glue line.

[0071] A glue line can be formed by the proper adhesive matter with which are satisfied of an aforementioned refractive index and all aforementioned light transmissions. Rather than points, such as the easy nature of adhesion, a binder, a gel sheet, etc. which consist of a slime can use preferably. As the slime, a well-known proper thing can be used, for example by binders, such as rubber system polymer, acrylic polymer, vinyl alkyl ether system polymer, and silicone system polymer. Above all, what uses the acrylic polymer using the alkyl ester of an acrylic acid or a methacrylic acid as a component from points, such as transparency and thermal resistance, is used preferably.

[0072] Incidentally as an example of the aforementioned acrylic polymer A methyl group, an ethyl group, a propyl group and a butyl, an isobutyl machine and an amyl group, An isoamyl machine, a hexyl machine, a heptyl machine and a cyclohexyl machine, a 2-ethylhexyl machine and an octyl machine, An iso octyl machine, a nonyl machine, an iso nonyl machine, a decyl group, a undecyl machine and a lauryl machine, The thing using one sort of the acrylic-acid system alkyl ester which consists of ester of the acrylic acid with which the carbon number like a tridecyl machine, a tetradecyl machine, a stearyl machine, or an octadecyl machine has the straight chain of 1-20 or the alkyl group of branching, or a methacrylic acid, or two sorts or more etc. is raised.

[0073] Moreover, the aforementioned acrylic polymer may be what copolymerized one sort of the proper monomer according to the reforming purposes other than the acrylic-acid system alkyl ester described above if needed for the purpose of reforming of adhesion properties, such as increase of the molecular weight by the adhesive improvement by introduction of a functional group or a polar group, the cohesive force by control of the glass transition temperature of a generation copolymer and a heat-resistant improvement, and grant of crosslinking reaction nature, etc., or two sorts or more.

[0074] As an example of the aforementioned monomer for reforming, acrylic-acid system alkyl ester other than the above, An acrylic acid, a methacrylic acid, carboxy ethyl acrylate and carboxy pentyl acrylate, The carboxyl group content monomer like an itaconic acid, a maleic acid, boletic acid, or a crotonic acid, An acid-anhydride monomer, acrylic-acid (meta) 2-hydroxyethyl and acrylic-acid (meta) 2-hydroxypropyl like a maleic anhydride or itaconic acid anhydride, Acrylic-acid 4-hydroxy butyl and an acrylic-acid (meta) 6-hydroxy hexyl, (Meta) An acrylic-acid 8-hydroxy octyl and an acrylic-acid (meta) 10-hydroxy desyl, (Meta) The hydroxyl content monomer like acrylic-acid 12-hydroxy lauryl or - (4-hydroxymethyl cyclohexyl) methyl acrylate, (Meta) A styrene sulfonic acid, an allyl-compound sulfonic acid, a 2-(meta) acrylamide-isobutane sulfonic acid and an acrylamide (meta) propane sulfonic acid, The sulfonic group content monomer like sulfo propyl (meta) acrylate or a (meth)acryloyloxy naphthalene sulfonic acid and the phosphate group content monomer like 2-hydroxyethyl acryloyl phosphate are raised.

[0075] Moreover (meta), an acrylamide and N and N-dimethyl (meta) acrylamide, N-butyl (meta) acrylamide and N-methylol (meta) acrylamide, The amide system monomer like N-methylol propane (meta) acrylamide (N-substitution), Acrylic-acid aminoethyl and acrylic-acid (meta) N and N-dimethylaminoethyl, (Meta) The acrylic-acid alkylamino alkyl system monomer like acrylic-acid t-butylamino ethyl (meta), (Meta) The acrylic-acid alkoxy alkyl system monomer like acrylic-acid methoxy ethyl or acrylic-acid (meta) ethoxy ethyl (meta), (Meta) The maleimide system monomer like N-cyclohexyl maleimide, N-isopropylmaleimide, N-lauryl maleimide, or N-phenyl maleimide, N-methyl itaconimide, N-ethyl itaconimide, N-butyl itaconimide and N-octyl itaconimide, N-2-ethylhexyl itaconimide and N-cyclohexyl itaconimide, The itaconimide system monomer, N-(meth)acryloyloxy methylene succinimide and the N-(meta) acryloyl-6-oxy-hexamethylene succinimide like N-lauryl itaconimide, The succinimide system monomer like an N-(meta) acryloyl-8-oxy-octamethylene succinimide is also raised as an

example of the monomer for reforming.

[0076] Furthermore, vinyl acetate, a propionic-acid vinyl, N vinylpyrrolidone and a methyl vinyl pyrrolidone, A vinylpyridine, a vinyl piperidone, a vinyl pyrimidine and a vinyl piperazine, A vinyl pyrazine, a vinyl pyrrole and a vinyl imidazole, and a vinyl oxazole, A vinyl morpholine, N-vinyl carboxylic-acid amides and styrene, and an alpha methyl styrene, The vinyl system monomer, the cyanoacrylate system monomer like acrylonitrile or a methacrylonitrile like N-vinyl caprolactam, The epoxy-group content acrylic monomer like metaglycidyl acrylate, (Meta) An acrylic-acid polyethylene glycol and an acrylic-acid (meta) polypropylene glycol, (Meta) The glycol system acrylic ester monomer like acrylic-acid methoxy ethylene glycol or an acrylic-acid (meta) methoxy polypropylene glycol, (Meta) (Meta) The acrylic-ester system monomer like acrylic-acid tetrahydrofurfuryl, fluorine (meta) acrylate and silicone (meta) acrylate, or 2-methoxy ethyl acrylate etc. is raised as an example of the monomer for reforming.

[0077] On the other hand, a polyfunctional acrylate system monomer etc. can be used as a monomer for reforming if needed. Use of this polyfunctional acrylate system monomer makes it possible to carry out bridge formation processing in cross-linking-agent additive-free by post-bridge formation operation by irradiation of radiation, such as an electron ray, etc. As an example of a polyfunctional acrylate system monomer Hexane JIORUJI (meta) acrylate and ethylene (poly) GURIKORUJI (meta) acrylate, Propylene GURIKORUJI (meta) acrylate and neopentyl GURIKORUJI (meta) acrylate, (Poly) Pen TAERISURITORUJI (meta) acrylate and TORIMECHI roll pro pantry (meta) acrylate, Pen TAERISURITORUTORI (meta) acrylate, dipentaerythritol hexa (meta) acrylate, epoxy acrylate, polyester acrylate, urethane acrylate, etc. are raised.

[0078] Manufacture of acrylic polymer can be performed into the mixture of one sort or two sorts or more of each monomers with the application of a method with proper bulk-polymerization method by the solution polymerization method, the emulsion-polymerization method, radiation, etc., suspension-polymerization method, etc. A glue line can also be formed as a bridge formation processing layer by the method with proper internal bridge formation method, external bridge formation method, etc.

[0079] In addition, a glue line uses as a solution the adhesive constituent using the polymer described above, for example using a solvent etc. if needed, can develop it by the proper method on separator, and can form it on the expansion layer in what was used as the adhesive sheet by the method with the proper method which arranges and sheet-izes separator further.

[0080] A check by looking of the reflected type liquid crystal display by this invention is mainly performed through the transmitted light of the long side of a light guide plate. Although the reflecting layer 64 was formed in the liquid crystal display element at drawing 3, the check-by-looking state of a case was illustrated. According to this, at the time of lighting of surface light source equipment, the light alpha which carried out outgoing radiation is reflected through a reflecting layer 64 via a glue line 2, a polarizing plate 5, and liquid crystal layer 62 grade from the inferior surface of tongue of a light guide plate 1, it results in a light guide plate 1 via [a liquid crystal layer a polarizing plate, a glue line, etc.] reverse, and the display image (alpha) which penetrated the long side 22 is checked by looking.

[0081] In the aforementioned case, in this invention, since the leakage light beta 2 which carries out outgoing radiation of the strong leakage light beta 1 in the direction in which the angle shifted from the perpendicular direction of a transverse plane greatly to the liquid crystal display element, and carries out outgoing radiation in the direction of a transverse plane is weak, it can check by looking the display image which is excellent in display grace near the direction of a transverse plane through a long side.

[0082] On the other hand, when surface light source equipment uses the outdoor daylight of an astigmatism LGT, the light gamma which carried out incidence from the long side 22 of the upper surface of a light guide plate 1, and it results in a light guide plate 1, and can check by looking near the direction of a transverse plane in the state of excelling in display grace with little disorder according [the display image (gamma) which penetrated the long side] to a light guide plate etc. [via a glue line, a polarizing plate, a liquid crystal layer, a reflecting layer etc.] [according to the above] [

[0083] In this invention, it is desirable that laminating unification is carried out and it is in an adhesion state from points, such as the above-mentioned fall prevention of the contrast according for example to suppression of interface reflection of an optical element or parts, such as a diffusion layer and a polarizing plate, which forms a light guide plate and reflected type liquid crystal displays other than a liquid crystal display element. Proper things, such as the above-mentioned glue line, can be used for the adhesion processing, and it can also consider as the glue line which is made to contain the transparent particle described above to the glue line, and shows a diffusion function.

[0084]

[Example] The upper surface of the transparent board which consists of example 1 polymethylmethacrylate is cut with a diamond tool. It is 0.8mm in 2mm in width of face of 80mm, the depth of 130mm, and thickness of the incidence side, and thickness of an opposite edge. It has prism-like irregularity parallel to the incidence side in a 390-micrometer pitch in a curve side (drawing 5 b) the bottom, and is the range whose tilt angle of a shorter side side is 36.5 - 39 degrees. an inferior surface of tongue (outgoing radiation side) -- flatness and the upper surface -- the opposite edge from the incidence side -- going -- the top near a flat surface -- a protrusion -- It changes in the range whose tilt angle of a long side is 1.1 - 1.5 degrees, less than 0.1 degrees have tilt-angle change of a nearby long side, and the projected area ratio [as opposed to the inferior surface of tongue of 10-21 micrometers, and a long side / shorter side side in the projection width of face to the inferior surface of tongue of a shorter side side] obtained 17/1 or more light guide plates. In addition, formation of prism-like irregularity was started from the position distant from the incidence side 2mm.

[0085] Next, stick the edge to the vertical end face of a light guide plate with the light source electrode holder which consists of polyester film which has arranged the cold cathode tube with a diameter of 2.4mm on the incidence side of the aforementioned light guide plate, and performed silver vacuum evaporation, and it surrounds. Monochrome reflection type TN liquid crystal

display element which has the reflective sheet which connected an inverter and DC power supply to the cold cathode tube, obtained surface light source equipment, and applied to the aforementioned light source electrode holder correspondingly at the tooth back at the optical outgoing radiation side (light guide plate undersurface) Adhesion arrangement was carried out through the acrylic pressure sensitive adhesive sheet of 300 micrometers in thickness, a refractive index 1.47, and 91% of all light transmissions, and the reflected type liquid crystal display was obtained.

[0086] TN liquid crystal display element has only been arranged to the optical outgoing radiation side of surface light source equipment, without carrying out adhesion arrangement through the example acrylic pressure sensitive adhesive sheet of comparison, and also the reflected type liquid crystal display was obtained according to the example 1.

[0087] The following property was investigated about the surface light source equipment and the reflected type liquid crystal display which were obtained in the evaluation examination example and the example of comparison.

[0088] Outgoing radiation on-the-strength surface light source equipment was made into the lighting state, and the angle property of the outgoing radiation intensity in the vertical side of a light guide plate core was investigated in the luminance meter (made in Thompson, BM7). Measurement was performed changing an angle on the basis of the direction of a normal to the undersurface in a perpendicular field] to the undersurface and the incidence side. In order to set a measuring-plane product constant, the obtained measured value hung the cosine of the measurement angle theta on it, asked for the outgoing radiation intensity in theta, and it asked also for the direction of outgoing radiation of the maximum intensity collectively. The outgoing radiation intensity (correspondence outgoing radiation intensity) of the maximum intensity in the undersurface, its direction and the maximum on-the-strength direction of the undersurface in the upper surface, and the mirror symmetrical direction on the basis of a normal and the undersurface was shown in the following **.

[0089] It had the hole with a 30 solid quantity of light diameter of 10mm, and the fixture of the shape of a cylinder which carried out the lusterless black paint of the inside was installed so that the solid angle which the light-receiving side of an illuminometer, the hole of the above [side / which counters], and an illuminometer makes might become 30 degrees, and the quantity of light which carries out outgoing radiation to less than 30 solid angles in the vertical side of the surface light source equipment of a lighting state using it was investigated. The result was shown in the following **.

[0090] In the drive state of transverse-plane brightness and a visibility reflection type liquid crystal display, the transverse-plane brightness and visibility in a white state were investigated under the lighting state of surface light source equipment. The result was also shown in the following **. In addition, when the transverse-plane brightness when not arranging surface light source equipment was similarly investigated for reference, it was 28 cd/m².

[0091]

	実施例 1	比較例
下面側最大強度角度 (度)	1 6	同左
下面側最大強度 (cd/m ²)	6 8 0	同左
上面側対応出射強度 (cd/m ²)	3 4	同左
上面側/下面側対応・最大出射強度比	0. 0 5 0	同左
下面側立体 3 0 度光量 (L X)	1 4. 5	同左
上面側立体 3 0 度光量 (L X)	1. 3	同左
正 面 輝 度 (c d / m ²)	5 0	4 5
視 認 性	良 好	白ボケ発生

* NOTICES *

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1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] Outgoing radiation of the incident light from the incidence side is carried out from an inferior surface of tongue through the optical outgoing radiation means which consists of prism-like irregularity formed in the upper surface. While the maximum on-the-strength direction of the outgoing radiation light from an inferior surface of tongue is in less than 30 degrees to the normal over the base plane of the inferior surface of tongue and the maximum intensity of the leakage light from the upper surface in the direction of the less than 30 aforementioned degrees is 1/5 or less [of the aforementioned maximum intensity in an inferior surface of tongue] The reflected type liquid crystal display characterized by carrying out adhesion arrangement of the liquid crystal display element to which the incident light from an inferior surface of tongue possesses a reflecting layer through the glue line of refractive indexes 1.40-1.55 and 90% or more of all light transmissions in the inferior-surface-of-tongue side of the light guide plate penetrated from the upper surface.

[Claim 2] It consists of a repetitive construct of 50 micrometers - 1.5mm pitch of the continuation which an optical outgoing radiation means becomes from a shorter side side and a long side, or discontinuous prism-like unevenness in a claim 1. And while the aforementioned shorter side side consists of a slant face which carries out a declivity to the opposite one end from an incidence side side to a base plane at the bottom by the tilt angle of 30 - 45 degrees, and projection width of face of 40 micrometers or less The aforementioned long side is in the tilt-angle range of 0 ** -10 degree to the base plane concerned, the angle difference of the whole is less than 5 times, and the tilt-angle difference between nearby long sides is less than 1 time. And the reflected type liquid crystal display using the light guide plate with which the projected area to the base plane concerned consists of a slant face which is 5 or more times of that of a shorter side side.

[Claim 3] The reflected type liquid crystal display using the light guide plate which has the direction of a ridgeline of prism-like irregularity in less than **30 degrees to the base plane of the incidence side in a claim 1 or 2.

[Claim 4] The reflected type liquid crystal display which used the light guide plate in claims 1-3 as surface light source equipment which has arranged the light source on the incidence side.

[Translation done.]